

# The Critical Exponent for Continuous Conventional Powers of Doubly Nonnegative Matrices.

(Adventures in Mathematics)

Ignore convention! Use the element of surprise!

Deny any supposed boundary between math and art!

LSA graduate student Olivia Walch combines calculations with comics,  
not to explain a bunch of stodgy rules,  
but to illustrate why MATH RULES.

by Elizabeth Wason



AND ZEUS SPRANG  
FORTH FROM THE HEAVENS  
AND SAID UNTO THE PEOPLE,

ok so like some of you  
are going to be good at math  
and the rest of you are  
going to suck

and that's  
just how  
it's gonna  
be

1

Follow the numbered  
panels to view the  
printed debut of Walch's  
graphic essay "Some  
Myths About Math,"  
published here in full.









### Olivia Sez:

"One of the jokes about Harry Potter is that there's magic at Hogwarts, but he's a C student. If you knew magic existed, wouldn't you want to spend all your time learning how to do stuff with magic? **Only Hermione really gets it.** She's like, 'Magic exists! I'm gonna learn everything about it!' For me, it's that if I have an idea, I can actually make it a reality through math. Math is out there! Why wouldn't I want to spend all my time learning how to do these cool things?!"



## If anyone tells you that math and art don't mix, slap them upside the head.

Because this —" Olivia Walch says, gesturing to a desktop demo of the phone app she's been working on, "shows that the two are obviously best buds."

Walch is talking about the Draw Anything mobile app that she created with Matt Jacobs, her friend and fellow Ph.D. student in LSA's Math Department. They won first place for it in the fifth semi-annual MHacks competition last year, where they programmed the whole app in just 36 hours. The MHacks event was invented by the student organization MPowered to encourage entrepreneurship by challenging students to design, code, and build digital projects with commercial potential.

Draw Anything invokes the magic of math to offer step-by-step tutorials for how to draw any uploaded image. Using math and high-speed computations in the cloud, the app generates increasingly complex outlines of the image for an aspiring artist to follow. Walch animates her demo of the app with examples for drawing Mario, Pokémon, and Homer Simpson. But when

the app translates Beyoncé's face into a mess of scribbles, Walch admits that they're still working to improve its accuracy.

To that end, she and Jacobs are knee deep in optimizing the app's edge detection capabilities — the first step in the app's calculations, and a fertile field of applied math research that's necessary for things like medical imaging, self-driving cars, and automatically tagging friends' faces in Facebook photos.

But why would anyone take art advice from a mathematician?

### Walch Innovations (part 1)

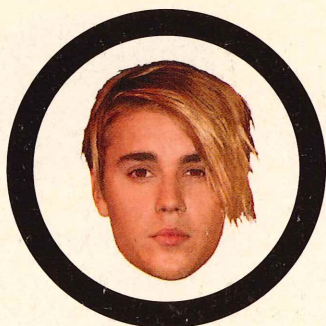
#### BATHROOM SOUNDSCAPE:

Walch's first mobile app. It "plays ambient bath-related noises for those times when you're stuck in a restroom without a fan." She created it with math Ph.D. student David Renardy. "It is exactly as classy as it sounds," say its creators. Her experience making Bathroom Soundscape was the reason that Walch began working on a jet lag app — her collaborators needed her valuable programming skills.



AFTER SUCCESSFULLY DRAWING POKÉMON AND HOMER SIMPSON, THE **DRAW ANYTHING APP TRANSLATES BEYONCÉ'S FACE INTO A MESS OF SCRIBBLES.** WALCH ADMITS THAT THEY'RE STILL WORKING TO IMPROVE ITS ACCURACY.





## Walch Innovations (part 2)

### JUSTIN BIEBER TATTOO INVENTORY APP:

Pretty much what you think it is. Walch created it with the middle-school student she mentors through Big Brothers Big Sisters of America.

SHE COULD'VE COMPUTED HER PROBABILITY OF WINNING AMERICA'S NEXT GREAT CARTOONIST CONTEST AS 0.2%, BUT THE SUBVERSIVE HILARITY OF HER STRIP TIPPED THE ODDS IN HER FAVOR.

## LAST COMIC STANDING

Walch isn't your average mathematician. While her true love is math, she came close to being a syndicated cartoonist. Her comic, *Imogen Quest*, won the America's Next Great Cartoonist contest, held by the *Washington Post*, while Walch was still an undergraduate. Her probability of winning the contest could have been calculated as a scant 0.2 percent amid the pool of 500 entries, but the subversive hilarity of her strip tipped the odds in her favor.

At 20 years old, Walch was not only the youngest finalist in the contest, but also the sole finalist with two X chromosomes. The *Washington Post* ran Walch's comic every day for a month and offered to consider publishing it as a syndicated strip. "That was a really cool part of the prize," Walch says. "And as awesome as syndicated cartooning

would be, to me, doing research and getting my degree was more awesome."

She still draws *Imogen Quest* every week as a webcomic, but she'd already made up her mind to go to graduate school.

## DO THE MATH

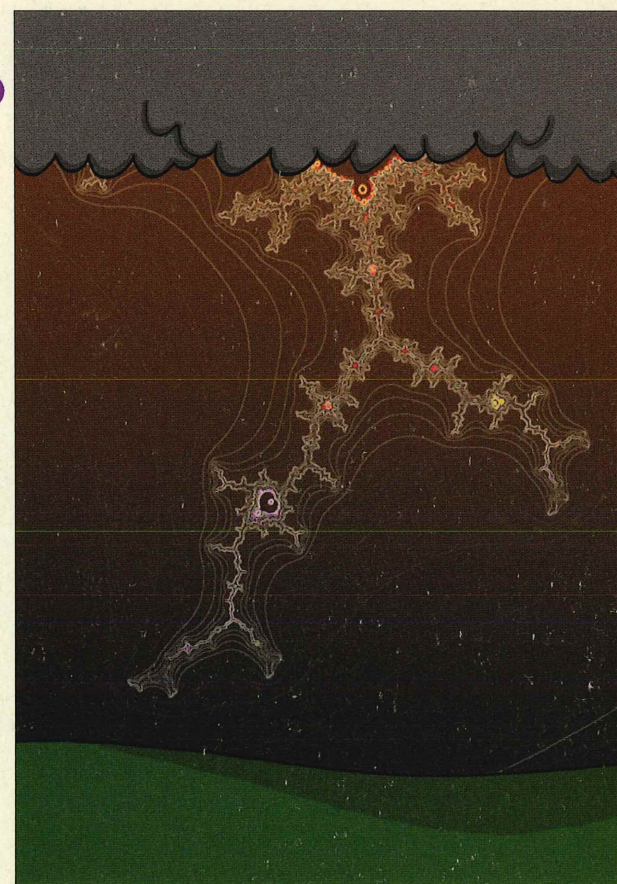
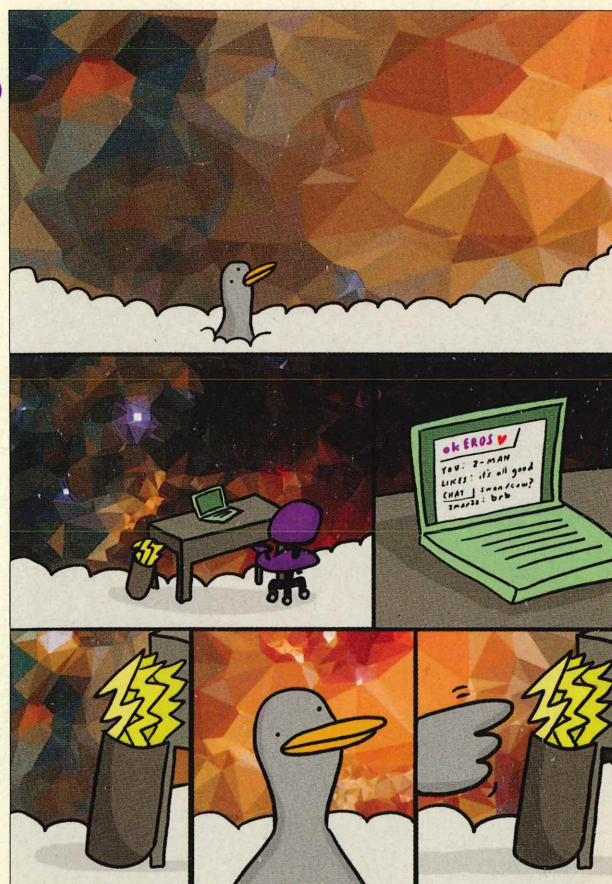
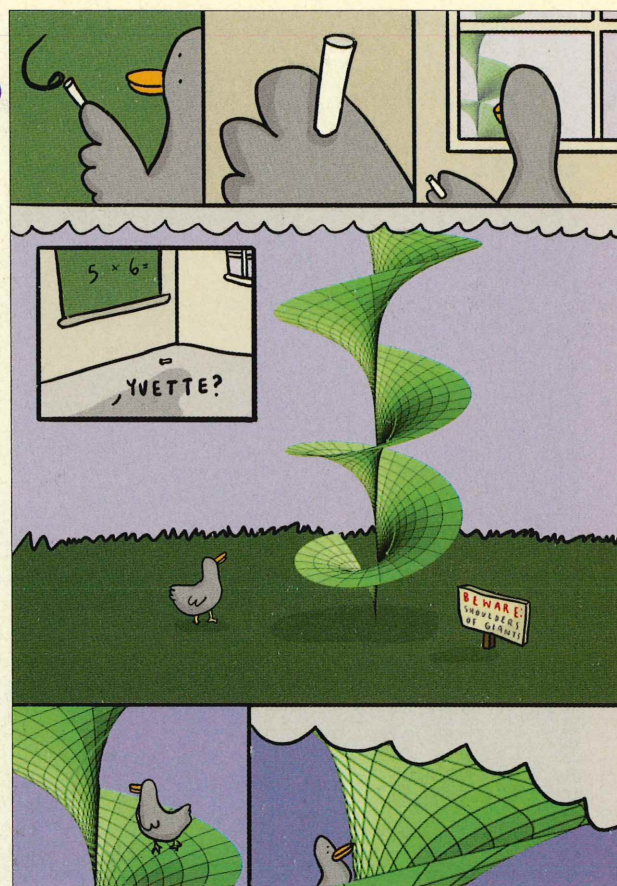
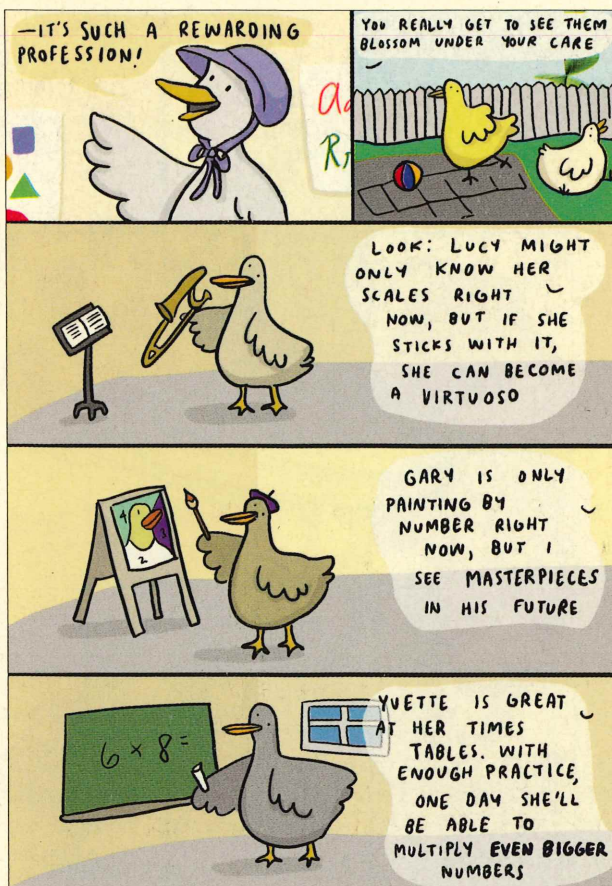
An undergraduate research project about tridiagonal matrices was what first made Walch's heart skip beats for math. "I was finding something that I couldn't Google. Only I knew the answer in that moment. I thought, 'I have awesome power. I'm starting into the edges of the known universe.' And that was pretty addictive." Her Ph.D. thesis is about the mathematics of circadian rhythms, otherwise known as biological clocks. She uses equations to describe how specialized cells in our eyes collect information about ambient light and help maintain our daily sleep cycles.

Walch stays agile hopping between algorithms and art. She plays around with edge detection and triangulation, painting digital "triangle art" portraits of her math heroes: for example, Grace Hopper, a computer scientist who ranked high in the Navy



One of Walch's more mathematical strips from her weekly webcomic, *Imogen Quest*.



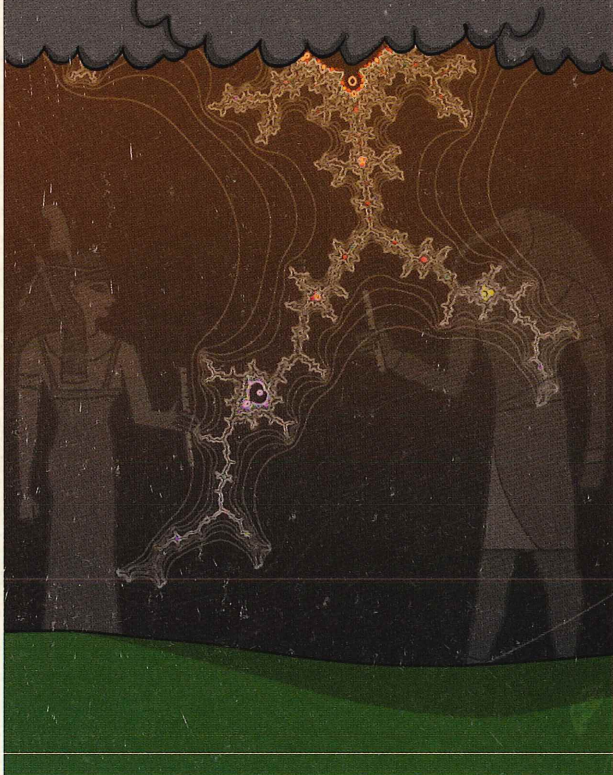


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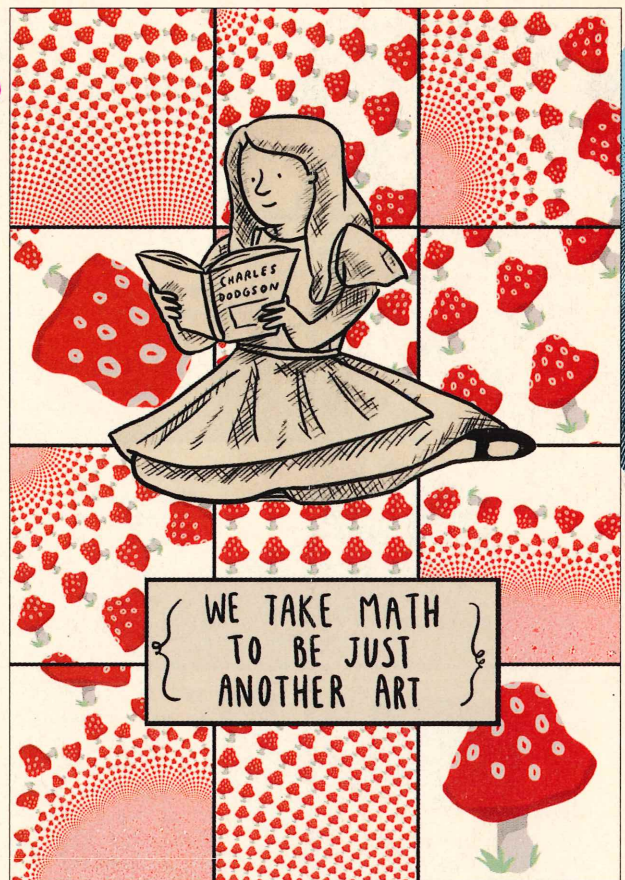


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OR: what if, *instead*,

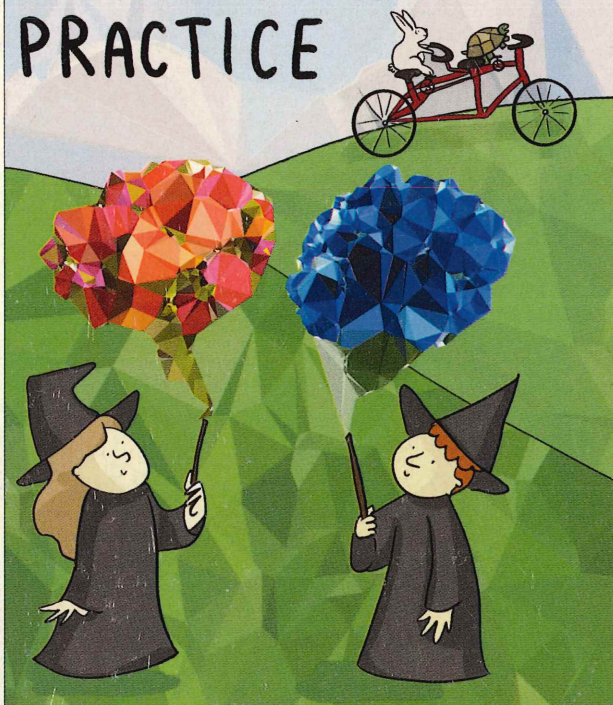


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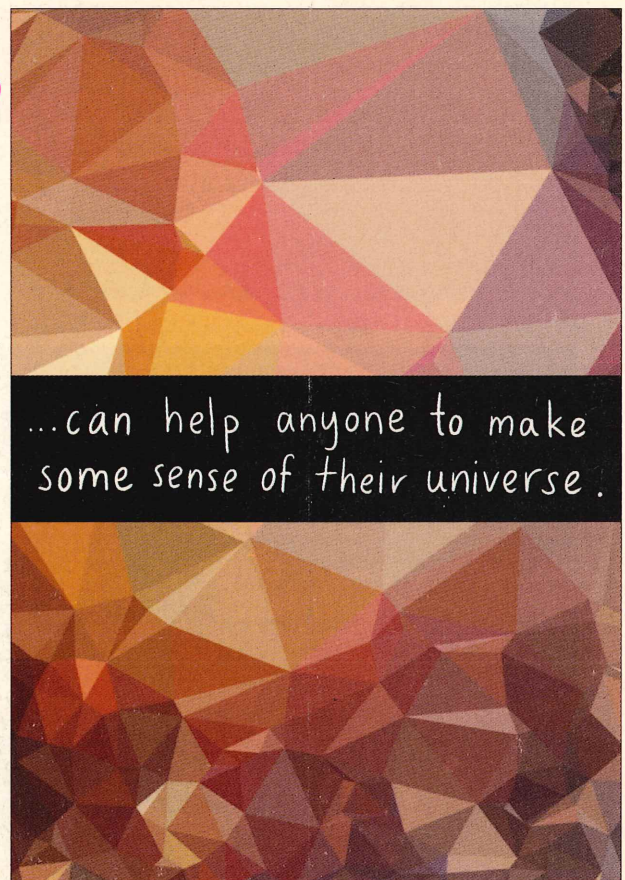


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ONE THAT WITH  
PASSION AND  
PRACTICE

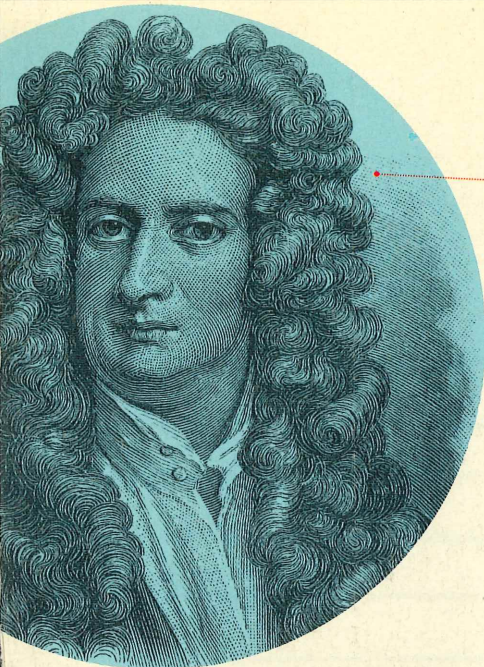


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### Fun Fact!

Isaac Newton drew boring squares around his integrals, but Gottfried Leibniz came up with the **elegant swoosh** notation that we use in calculus today. Mathematicians who draw, take note: Your illustrations may live on for hundreds of years.



### Walch Innovations (part 3)

#### PRODUCTIVITY PONY:

A computer program by Walch and Renardy that connects your word count goals in a writing project to the health and happiness of a pony you create. You set your word count, and your pony eats that amount each day — unless you don't write, in which case it starves.



and coined the term “debugging” for fixing a computer glitch; and Emmy Noether, the woman who invented modern algebra. Her comics find the lighter side of math, such as when Walch imagines a forbearing calculus teacher who allows students to text in the classroom — so long as the “texting” is limited to typing 80085 in their calculators.

Another of her comics draws on a classic example from game theory to decide whether you should reply-all to unsubscribe from an email listserv. (Sadly, you should.) And she name-drops Cartesian coordinates to illustrate a point about her comics. “If you want to know a point, you need an x- and a y-coordinate,” she explains. “If I just give you a y-coordinate, it’s just a line, and there are so many choices for the x-coordinate. Same with comics: You need the comic and the intended audience to truly understand the jokes.”

She’s convinced that math gives us a new vantage point for viewing the world, along with new vocabulary that allows for better communication. “I think we have to spread the gospel of math, so that we can talk to each other more easily,” she says. Walch laments that math sometimes is perceived as a sort of secret mystical process that only a select few can understand and use. She believes that, soon enough, “learning more math is going to become commonplace, because we’re going to get better at teaching it. And then, when math is part of how we communicate with each other, we’re going to have a better ability to make our ideas clear, pose our statements properly, and put our ideas together. Talking to each other is going to get better and better.”

Which is great, she says, “for somebody like me, who walks around saying things like, ‘Maybe we should add math to that.’” ■

WALCH IS CONVINCED THAT MATH GIVES US A NEW VOCABULARY THAT ALLOWS FOR BETTER COMMUNICATION. **“I THINK WE HAVE TO SPREAD THE GOSPEL OF MATH, SO THAT WE CAN TALK TO EACH OTHER MORE EASILY,” SHE SAYS.**



